EFFECTS OF COMPUTER ASSISTED INSTRUCTION ON STUDENTS' ATTITUDES TOWARDS SCIENCE COURSES IN TURKEY: A META-ANALYSIS*

Ahmet TEKBIYIK
atekbiyik@gmail.com

Kader BİRİNCİ KONUR
kaderbirinci@yahoo.com

Nimet PIRASA
npirasa@ktu.edu.tr

Rize University, Faculty of Education, Department of Primary Education, 53200, Rize /Turkey

ABSTRACT

Many primary studies have been performed to reveal the effects of computer assisted instruction (CAI) on students' attitudes towards science courses. In determining the effectiveness of these studies, gathering and evaluating of the studies at some characteristics play an important role. The aim of this study is to determine meta-analytically the overall effectiveness of CAI on students' attitudes towards science courses from the years 2000 to 2007 in Turkey.

This paper reported the results of 23 effect sizes included in 17 studies, since some studies performed multiple comparisons within the same study. The overall number of subject was 1583. Grand mean for 23 ESs was calculated as 0,68. When this mean ES was converted to percentiles, the percentiles on students' attitudes towards science course were 75 for the CAI group and 50 for TI group. In other words, an average student's attitude towards science course moved from the 50th percentile to the 75th percentile when computer assisted instruction was used.

Keywords: CAI, Students' Attitudes, Meta-analysis, Science Courses

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INTRODUCTION

Usage of computers in science education becomes popular in Turkey like all over the world. Owing to the fact that science has many theoretical and abstract concepts that are difficult to understand by students and of that students need visual materials to learn them, the importance of computer assisted instruction (CAI) has increased more. There are a lot of important reasons to use computer in science education. They can provide text, graph, audio, video, picture, animation and simulation in the same media to students. Simulations foster learning and help students to see different aspects of a subject and generalize it (Akpınar & Ergin, 2007).

CAI has various effects on students such as academic achievement, attitudes toward course. Students' attitudes are one of the key factors in learning science. Learning process is important in improving of positive attitudes (Tekbıyık & İpek, 2007). The development of positive attitudes toward science can motivate student interest in science education and science-related careers (George, 2006). Some studies showed that CAI was more effective than the other methods in increasing students' interests in science lessons (Geban, Aşkar & Özkan, 1992; Hounshell & Hill, 1989) and during teaching process computer assisted applications aid the consolidation of attitudes and the restructuring of the knowledge by students themselves (Saka & Akdeniz, 2006).

Many studies have been performed about the effects of CAI on students' attitudes do not agree whether it makes positive changes in attitudes towards science and science lessons. (Francisa, et al, 2000; Mitra, 1998). Although Selwyn (1999) and Ertepınar, et al. (1998) reported that CAI improves a positive attitude towards science, Shaw and Marlow (1999) found that CAI does not show a positive effect on students' attitudes (Çepni et al., 2006).

The primary studies that investigate phenomenon directly have been carried out to determine the effect of CAI on students. Evaluation of these studies plays an important role at certain characteristics by gathering them together for determination of the effectiveness of CAI. Meta-analysis is an effective review method used for evaluating of such studies generally.

Meta-analysis refers to the critical review and integration of the findings of separate studies. In a meta-analysis, the researcher compares outcomes across several studies using quantitative methods. The goal is to summarize the findings and characteristics of a group of different studies (Göçmen, 2005). The method focuses on a common problem or topic and pools findings of several studies in an effort to draw inferences as to the meaning of a collective body of research (Hannafin, et al, 1996). Basically meta-analysis helps researchers to translate results from different studies to a common metric and statistically explore the relations between the characteristics and findings of the studies.

During the past three decades, a large number of meta-analyses have systematically examined the effects of technology on student outcomes. Kulik and his associates have reported several studies focused on the effectiveness of computer based education in elementary and secondary schools, colleges and adult education (Kulik & Kulik, 1986; Kulik & Kulik, 1991; Kulik, Kulik & Schwalb, 1986; Kulik, Kulik & Bangert-Drowns, 1985; Kulik, Kulik & Cohen, 1980). In these studies, positive outcomes on students were found in favour of computer assisted instruction.

Several studies have been conducted in order to determine the effects of computer assisted instruction in science education like all other subject areas. Yet, any studies have not been reported from Turkey that could provide an insight into the effectiveness of CAI on students' attitudes towards science courses.

Purpose of the Study

The purpose of the study is to determine the overall effectiveness of CAI on students' attitudes towards science courses from the year 2000 to 2007 meta-analytically in Turkey. Furthermore, the study also investigates the effects of variables such as grade level and subject area on the attitudes.

METHOD

Research Model

In the present study, data were analyzed using meta-analysis technique that is a secondary statistical analysis using primary researches. Our approach is similar to Kulik et al. (1985) and Glass, McGaw & Smith's (1981): firstly we located objective and replicable studies from reliable sources. Then, we coded these studies for prominent properties and created a common scale by outcomes of studies. Finally, we performed statistical methods to the studies' outcomes and calculated effect sizes.

In order to calculate the effect sizes, Hedge's g (Hedges & Olkin, 1985), also known Hunter and Schmidt's d (Hunter & Schmidt, 1990), was used in this analysis. SPSS package program was used to compute ESs and variability measurement. A Kruskal Walli's analysis was performed to to investigate whether there were significant differences within each variable on the ESs.

Data Sources

In order to gather the studies included in meta-analysis, various sources were used in the study. Three type studies were brought together for the meta-analysis: journal article, dissertations/theses and conference papers. The Social Science Citation Index (SSCI) journals, Turkish Academic Network and Information Center Social Science Database, national printed journals, Academic Search Complete and Education Research Complete databases were searched for journal articles. Council of Turkish Higher Education Thesis Center was scanned to get the dissertations/thesis. The conference papers were collected from the papers of prominent conference of science education, educational technologies and educational sciences in Turkey. So, 17 studies were used overall in the meta-analysis.

Inclusion Criteria

The following criteria were established for choosing studies included in the meta-analysis.

1. Studies had to compare the effects of computer assisted instruction and others (traditional instruction, laboratory based, etc.) on students' attitudes toward science courses.

2. Studies had to include experimental method with experimental and control group. Studies including no comparison group were not used in the analysis.

3. Studies had to report quantitative results.

4. Studies had to include Turkish students as subjects.

5. Studies had to report means, standard deviations and number of subjects of experimental and control groups separately (If these were not reported, F or t values had to exist).

6. Studies had to be published between 2000-2007 years.

Coding

Studies were chosen to use in meta-analysis. Then, a coding paper prepared for coding process. Two researcher coded variables and quantitative data needed to calculate effect sizes to the paper for each study separately. The researchers compared the coding papers for coding reliability. Agreement was obtained 0.90 between the coding papers. The different codings were discussed by the researchers.

Variables

Two variables were coded for each study;

1. Grade level (elementary, secondary or university)

2. Subject area (Physics, chemistry, biology)

FINDINGS

As can be seen from Table 1, the study reported the results of 23 effect sizes included in 17 studies, since some studies performed multiple comparisons within the same study. The overall number of subject was 1583. While 17 (74%) effect sizes in the present analysis were positive and favored the computer assisted instruction (CAI), 6 (26%) effect sizes were negative and favored traditional instruction (TI) (Figure 1). The range of the ESs was from -2,29 to 3,66. Grand mean for 23 ESs was calculated as 0,68.

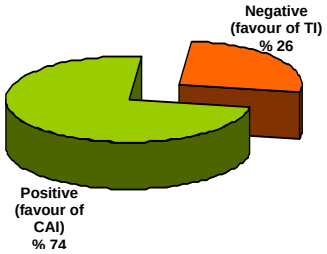

Figure 1. Percentages about Direction of Effect Sizes

Table 1. Publishing Year, Number of Comparisons and Effect Sizes of Each Primary Study

Authors of the studies	**Year**	**Number of ES**	**ES**
Akçay, et al.	2006	2	1,06 0,70
Akçay, Tüysüz & Feyzioğlu	2003	4	1,23 3,45 2,52 3,66
Akgün	2005	1	-0,17
Akpınar & Ergin	2007	1	0,26
Çavaş	2005	1	1,43
Çepni, Taş & Köse	2006	1	-2,28
Çömek & Bayram	2004	1	0,21
Demirer	2006	1	0,44
Gönen, Kocakaya & İnan	2006	1	-0,14
Güney, Özmen & Kenan	2007	1	-2,28
İlbi	2006	1	0,22
Kara & Yeşilyurt	2006	2	0,61 0,72
Olgun	2006	1	0,23
Özmen	2007	1	1,61
Sarıçayır	2007	2	-0,12 -0,10
Tekmen	2006	1	1,15
Yenice	2003	1	1,24
Grand Mean Of ESs			**0,68**
Grand Median Of ESs			**0,61**

A Kruskal Wallis analysis was performed to determine whether students' attitudes changed when CAI was used in accordance to the grade level and subject area. This analysis was chosen because the distributions were not normal. Table 2 shows Kruskal Wallis analysis results that indicated statistically no significant effect at 95% confidence level students' attitudes in accordance with the grade level and subject area.

Table 2. Kruskal Wallis Analysis Results for Variables

Variables	**N**	**Mean Rank**	**df**	χ^2	**p**
Grade level of samples					
Elementary (4^{th}-8^{th} grade)	12	13,42	2	1,763	0,414
Secondary (9^{th}-12^{th} grade)	9	9,67			
University	2	14,00			
Subject area					
Physics	5	9,60	2	1,749	0,417
Chemistry	11	13,91			
Biology	7	10,71			

CONCLUSION

In the present study, grand mean for 23 ESs included 17 studies was found as 0,68. The grand mean effect size can be interpreted medium, since an effect is said to be medium when ES=0,50 and large when ES=0,80 (Cohen, 1977). When this mean ES was converted to percentiles, the percentiles on students' attitudes towards science course were 75 for the CAI group and 50 for TI group. In other words, an average student's attitude toward science course moved from the 50^{th} percentile to the 75^{th} percentile when computer assisted instruction was used. It is important result that not only medium level grand mean effect size but also 74% of all ESs favored of CAI. So, it can be said that CAI is effective in obtaining positive attitudes to student toward science courses.

Even though no significant effect of CAI on student's attitudes towards science courses in accordance with grade level, mean ranks show that CAI is more effective at university and elementary level than at secondary in changing students' attitudes toward science courses. Similarly, CAI on student's attitudes towards science courses in accordance with grade level was no significant effect statistically, but mean ranks pointed out that CAI in changing students' attitudes toward chemistry courses is more effective than biology and physics courses. Since there is no any literature about this area, any comparison could not be reported with literature in the present study.

This study should be pattern for future studies about investigation of CAI meta-analytically. Similar studies can be report in other disciplines and with different variables.

REFERENCES

*Studies included in the meta-analysis.

*Akçay, H., Durmaz, A., Tüysüz, C. & Feyzioğlu B. (2006). Effects of computer based learning on students' attitudes and achievements towards analytical chemistry. *Turkish Online Journal of Educational Technology, 5(1)*.

*Akçay, H., Tüysüz, C. & Feyzioğlu, B. (2003). Bilgisayar destekli fen bilgisi öğretiminin öğrenci başarısına ve tutumuna etkisine bir örnek: mol kavramı ve avogadro sayısı. *Turkish Online Journal of Educational Technology, 2(2).*

*Akgün, Ö. E. (2005). Bilgisayar destekli ve fen bilgisi laboratuarında yapılan gösterim deneylerinin öğrencilerin fen bilgisi başarısı ve tutumları üzerindeki etkisi. *Yüzüncü Yıl Üniversitesi, Elektronik Eğitim Fakültesi Dergisi, (2)1*.

*Akpınar, E. & Ergin, O. (2007). The effect of interactive computer animations accompanied with experiments on 6th grade students' achievements and attitudes toward science. *International Journal of Emerging Technologies in Learning, 2(2)*, 36-41.

Cohen, J. (1977). *Statistical power analysis for the behavioral science (revised edition)*. New York: Academic Press.

*Çavaş, B. (2005). Bilgi ve iletişim teknolojileri ile bütünleştirilmiş fen bilgisi öğrenme ortamı üzerine bir araştırma. *Eurasian Journal of Educational Research, 21*, 88 – 102

*Çepni, S., Taş, E., & Köse, S. (2006). The effects of computer-assisted material on students' cognitive levels, misconceptions and attitudes towards science. *Computers & Education, 46*, 192–205.

*Çömek, A. & Bayram, H. (2004) Fen bilgisi öğretiminde ısı konusunun bilgisayar destekli materyaller ile öğretilmesi. VI. UFBMEK Marmara Ü. İstanbul, Türkiye.

*Demirer, A. (2006). İlköğretim ikinci kademede bilgisayar destekli fen bilgisi öğretiminin öğrenci başarısına etkilerine ilişkin bir araştırma Yayımlanmamış Yüksek Lisans Tezi, Dicle Üniversitesi, Türkiye.

Ertepınar, H., Demircioğlu, H., Geban, Ö., & Yavuz, D. (1998). The effect of assimilation and computer based instruction to understand mole concept. III. National Science Education Symposium, Karadeniz Technical University, Turkey.

Francisa, L. J., Katzb, Y. J., Susan, H., & Jonesc, S. H. (2000). The reliability and validity of the Hebrew version of the Computer Attitude Scale. *Computers & Education*, 35, 149–159.

Geban, Ö., Aşkar P., ve Özkan, İ. (1992). Effects of computer simulations and problem solving approaches on high school students. *Journal of Educational Research, 86(1)*, 5-10.

George, R. (2006); A Cross-domain analysis of change in students' attitudes toward science and attitudes about the utility of science. International Journal of Science Education, Vol. 28, No. 6, 571–589.

Glass, G. V., McGaw, B., & Smith, M. L. (1981). *Meta-analysis in social research*. Beverly Hills, CA: Sage Publications.

Göçmen, G. B. (2005). Meta-analysis. *Eurasian Journal of Educational Research, 15*, 16-22

*Gönen, S., Kocakaya, S. & İnan, C. (2006). The effect of the computer assisted teaching and 7E model of the constructivist learning methods on the achievements and attitudes of high school students. *Turkish Online Journal of Educational Technology, 5(4).*

*Güney, K. K., Özmen, H. & Kenan, O. (2007). İlköğretim 8. sınıf genetik ünitesine yönelik bilgisayar destekli bir materyalin geliştirilmesi ve etkililiğinin araştırılması 16. Ulusal Eğitim Bilimleri Kongresi, Gaziosmanpaşa Üniversitesi, Turkiye.

Hannafin, M., Hannafin, K., Hooper, S., Rieber, L., & Kini, A. (1996). Research on and research with emerging technologies. In D. H. Jonassen (Ed.), *Handbook of research for educational communications and technology* (pp.378–402). New York: Simon & Schuster, Macmillan.

Hedges, L. V. & Olkin, I. (1985). Statistical methods for meta-analysis. San-Diego, CA: Academic Press Inc.

Hounshell, P.B. & Hill, S. R. (1989). The microcomputer and achievement and attitudes in high school biology. *Journal of Research in Science Teaching. 26(6),* 543-549.

Hunter, J.E., Schmidt, F.L. (1990), Methods Of Meta-Analysis : Correcting Error And Bias İn Research Findings, London: Sage Publications

*İlbi, Ö. (2006). Ausubel'in sunuş yöntemi ile bilgisayar destekli öğretim yöntemlerinin kimya ünitelerindeki kavram yanılgılarının önlenebilmesi açısından karşılaştırılması Yayımlanmamış Yüksek Lisans Tezi, Dokuz Eylül Üniversitesi, Türkiye.

*Kara, Y. & Yeşilyurt, S. (2006). Bilgisayar destekli ve bilgisayar temelli öğretimin hücre bölünmesi konusunda öğrenci başarısına ve tutumlarına etkilerinin karşılaştırılması, *Proceedings of the 6th annual conference of the international educational technology*, Eastern Mediterranean University Famagusta - North Cyprus.

Kulik, C.-L., & Kulik, J. (1991). Effectiveness of computer-based instruction: an updated analysis. *Computers in Human Behavior, 7*, 75–94.

Kulik, C.-L., & Kulik, J. (1986). Effectiveness of computer-based education in colleges. *AEDS Journal, 19(2–3)*, 81–108.

Kulik, C. L., Kulik, J., & Schwalb, B. (1986). Effectiveness of computer-based adult education: a meta-analysis. *Journal of Educational Computing Research, 2(2)*, 235–252.

Kulik, J., Kulik, C.-L., & Bangert-Drowns, R. L. (1985). Effectiveness of computer-based education in elementary pupils. *Computers in Human Behavior, 1*, 59–74.

Kulik, J., Kulik, C.-L., & Cohen, P. (1980). Effectiveness of computer-based college teaching: a meta-analysis of findings. *Review of Educational Research, 50*, 525–544.

Mitra, A. (1998). Categories of computer use and their relationships with attitudes toward computers. *Journal of Research on Computing in Education*, 30(3), 281–294.

*Olgun, A. (2006). Bilgisayar destekli fen bilgisi öğretiminin öğrencilerin fen bilgisi tutumları, biliş üstü becerileri ve başarıya etkisi Yayımlanmamış Yüksek Lisans Tezi, Osmangazi Üniversitesi, Türkiye.

*Özmen, H. (2007). The influence of computer-assisted instruction on students' conceptual understanding of chemical bonding and attitude toward chemistry: A case for Turkey. *Computers & Education (in press).*

Saka, A. & Akdeniz, A. R. (2006). Genetik konusunda bilgisayar destekli materyal geliştirilmesi ve 5E modeline göre uygulanması, *Turkish Online Journal of Educational Technology*, 5 (1)

*Sarıçayır, H. (2007). Kimya eğitiminde kimyasal tepkimelerde denge konusunun bilgisayar destekli ve laboratuar temelli öğretiminin öğrencilerin kimya başarılarına, hatırlama düzeylerine ve tutumlarına etkisi Yayımlanmamış Doktora Tezi, Marmara Üniversitesi, Türkiye.

Selwyn, N. (1999). Students' attitudes towards computers in sixteen to nineteen education. *Education and Information Technologies*, 4(2), 129–141.

Shaw, G. & Marlow, N. (1999). The role of student learning styles, gender, attitudes and perceptions on information and communication technology assisted learning. *Computer & Education*, 33, 223–234.

Tekbıyık, A. & İpek, C. (2007). Sınıf öğretmeni adaylarının Fen Bilimlerine yönelik tutumları ve mantıksal düşünme becerileri. *Yüzüncü Yıl Üniversitesi Elektronik Eğitim Fakültesi Dergisi*, Cilt IV-Sayı I.

*Tekmen, S. (2006). Fizik dersinde, bilgisayar destekli eğitimin öğrencilerin erişişine, derse karsı tutumlarına ve kalıcılığa etkisi. Yayımlanmamış Yüksek Lisans Tezi, Abant İzzet Baysal Üniversitesi, Türkiye.

*Yenice, N. (2003) Bilgisayar destekli fen bilgisi öğretiminin öğrencilerin fen ve bilgisayar tutumlarına etkisi. *Turkish Online Journal of Educational Technology* 2 (4).